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Exploring The Link Between Early Adversity And Behavioral Health

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Background/Rationale Adverse childhood experiences (ACE) and their lasting sequelae are a significant public health concern. ACEs are a risk factor for increased risk of detrimental health behaviors, chronic disease morbidity, and mortality. Though this connection has been supported by an abundance of evidence, how best to address these issues in practice and in the community has yet to be confirmed. Prior research examining the health promoting factors exhibited by adults who have experienced several different ACEs yet have experienced few negative health outcomes, have identified social support, education, and physical activity as potentially protective factors. This study seeks to identify factors associated with improved health during childhood that may have the potential to prevent future poor outcomes.

Methods Multivariate analyses of child and family factors and their association with emotional and behavioral problems (EBD), BMI, resilience and their interactions with ACEs were carried out using data from the 2011-2012 National Survey of Children's Health. The 2011-2012 NSCH is a cross-sectional survey of the general population of children living in the United States.

Results Resilience was associated 70% lowered odds of EBD ($p<0.001$), but was not associated with BMI outcomes after adjustment (p-0.311). Children who participated in organized sports were 1.27 (95%CI: 1.07, 1.49) times as likely to demonstrate resilience, 0.69 (95%CI: 0.58, 0.81) and 0.80 (95%CI: 0.68,0.94) times as likely to have a diagnosed EBD or have a BMI above the 85th percentile, respectively. Among children aged 2-5, those that played with other children at least 4 times per week had 0.65 (0.44, 0.97) times the odds of EBD compared to those that did not. Only parental social

support was found to significantly weaken the relationship between cumulative ACE scores and EBD outcomes (p-0.001).

Discussion This investigation identified several significant associations that are associated with better health and behavioral outcomes among all children and those exposed to high ACEs. However, the cross-sectional nature of this study limits the assertion that these factors have the potential to provide protective benefits. More long-term longitudinal studies on young children are needed to confirm these findings and better characterize their relationship with resilience and improved outcomes.

Introduction

Adverse childhood experiences (ACEs), first identified by the Adverse Childhood Experiences Study published in 1998, are significant risk factors for detrimental health behavior, chronic disease, and overall increased morbidity and mortality[1]. ACEs are defined as exposure before age eighteen to: emotional, physical, or sexual abuse; physical neglect; emotional neglect domestic violence; separation/divorce; and parental/familial substance abuse, incarceration, or mental health problems. The ACE Study, conducted by the Centers for Disease Control and Prevention (CDC) in collaboration with Kaiser Permanente, was a large-scale longitudinal investigation of 9,508 adult men and women aged twenty-five and older from the general population.

Results from the study demonstrated that slightly over half (52%) of participants had experienced at least one ACE and that there existed a clear dose-response relationship between the number of ACEs experienced and each of the risk factors examined – smoking, severe obesity, physical inactivity, depression, attempted suicide, alcoholism, drug abuse, having greater than 50 lifetime sexual partners, and a history of sexually transmitted disease – as well as with ischemic heart disease, cancer, chronic

bronchitis, emphysema, liver disease, skeletal fractures, and poor self-rated health[1]. Subsequent research conducted in the 18 years since the ACE Study was published have confirmed and expanded on many of these findings by further characterizing the link between traumatic events, chronic stress, psychiatric distress, systemic inflammation and chronic disease[2-6]. The findings of these studies have provided evidence that the accumulation of ACEs is associated with increased hypertension[6], enhanced activation of the hypothalamic–pituitary–adrenal (HPA) axis and inflammation levels[5].

While much of this research has been conducted in adult populations with retrospective reporting of childhood exposure, understanding the biological pathway between early trauma and health outcomes necessitates exploration of the immediate health consequences of early adversity. As such, several recent studies have sought to identify the earliest manifestations of adverse health consequences in children exposed to ACEs, particularly among those incurring several ACEs earlier in life. A recent study investigating cardiovascular health found that among children aged 11-14 exposure to 4 or more ACEs was significantly associated with increased BMI, waist circumference, and heart rate – all precursors for cardiovascular disease (CVD)[7]. In addition, studies based on data from the 2011-2012 National Survey of Children's Health (NSCH) demonstrated that ACEs were significantly associated with increased odds of overweight/obesity, asthma, behavioral and developmental problems, and decreased school engagement among 0-17 year olds in the general population[8-9]. These findings support previous longitudinal and cross-sectional analyses of poor emotional and behavioral health outcomes among children in the child welfare system[10-13].

While many of these studies have been limited by their cross-sectional and short-term longitudinal design in confirming a direct causal relationship between ACEs and negative outcomes during childhood, additional studies have been able to demonstrate a temporal relationship between childhood emotional/behavioral issues and health risk [14-16] as well as the systemic inflammation[17,19] previously linked to ACEs and believed to precede many of the chronic conditions also associated with ACEs. In addition, evidence from the Avon Longitudinal Study in the UK showed that early adversity was also predictive of heightened inflammation during childhood[20]. Taken together, these studies have helped to establish biological plausibility that ACE and early psychosocial stress may contribute to later in life health consequences by way of these processes.

While the published evidence appears to overwhelming support the notion that ACEs play a role in the development and exacerbation of several adverse health outcomes, even at fairly early time points, and as researchers continue to elucidate a distinct causal pathway at these earlier time-points, many in the pediatric medical community are seeking to determine ways to address these concerns in clinical practice. As part of the Affordable Care Act, the American Academy of Pediatrics (AAP) in partnership with the federal Maternal and Child Health Bureau have sponsored the national Bright Futures guidelines, which outline mandatory coverage for preventative services including recommendations for a focus on trauma informed care and screenings for ACEs[21]. However, best methods for widespread implementation of ACE screening and trauma-informed care have yet to be determined[22-23].

In tandem with this move towards addressing ACEs and their sequelea in practice, much focus has been placed on the concept of resilience and the identification

of protective factors in limiting the health consequences of ACE exposures. Ascertaining why some children and adults with high ACE scores do not engage in risky behavior, nor develop adverse mental and physical health outcomes may provide insight in how public health advocates can devise effective strategies to lessen the deleterious effects of childhood trauma in the general population. In their recent analyses of 2011-2012 NSCH survey data, Bethell and colleagues were able to demonstrate an inverse relationship between resilience –defined here as the ability to stay calm in difficult situations –and ACEs and child behavior problems among a nationally representative sample of 6-17 year olds. They were further able to identify several family characteristics associated with increased resilience among children with high ACEs and emotional, mental, or behavioral conditions [9,24].

In an attempt to contribute greater information about potentially protective factors for children with ACE exposures, the present study seeks to identify potential factors in the child's personal life and family environment that may contribute to this concept of resilience and may help mitigate the previously identified associations with negative health and behavior consequences observed among children with high ACE scores. In particular, this study aims to identify factors that are easily modifiable and accessible given the limitations of certain socioeconomic and geographic living situations and the difficulties associated with making significant behavior changes. As such, this analysis is based on a salutogenic approach to improving outcomes in high ACE children by focusing on personal resources and individual strengths. Prior salutogenesis research with respect to adults with high ACE exposures identified physical activity, education, and social support as key protective and health promoting factors[25]. In order to assess similar factors among high ACE children and their families, this investigation uses data

from the 2011-2012 NSCH to examine whether specific child and family activities contribute to the concept of resilience and are associated with emotional/behavioral and BMI outcomes among children with ACE exposures in the general population.

Methods

Study Population and Design

Data from the 2011-2012 NSCH was used to conduct this research investigation. The NSCH was conducted by the Maternal and Child Health Bureau and implemented through the National Center for Health Statistics. The cross-sectional survey assessed a nationally representative sample of children ages 0-17. Survey data was collected between February 28, 2011 and June 25, 2012 via telephone interview. A list-assisted random-digit-dial (RDD) sample of landline telephone numbers, supplemented with an independent RDD sample of cell-phone numbers was used to identify households with age-eligible children. Respondents, either a parent or guardian with knowledge of the health status and care of the children residing in the household, were asked to complete the survey for one of the children that meet criteria.

A total of 187,422 out of 847, 881 households screened from across all 50 US states were deemed eligible for participation. Of this sample 95,677 detailed surveys were completed, giving a completion rate of 51.0%. The resulting data were weighted to reflect the population of non-institutionalized children aged 0–17, nationally and in each state. The Child and Adolescent Health Measurement initiative (CAHMI), a national initiative based in the Johns Hopkins Bloomberg School of Public Health, prepared the publicly available data files and constructed variables in collaboration with the Maternal and Child Health Bureau and the National Center for Health Statistics[26].

Key Measures (Outcomes, Exposures, Covariates)

The 9 types of ACEs surveyed by the 2011–12 NSCH were based on exposures assessed in the original adult ACE study conducted by the CDC. Survey item testing was performed by a technical expert panel and evaluated by the National Center for Health Statistics. Adaptations were made to include measures determined to be valid for parent and guardian reporting. These measures include – economic hardship; parental divorce; loss of a parent to death and/or incarceration; witnessing domestic violence; witnessing or experiencing neighborhood violence; living with someone with alcohol/substance abuse, and/or mental health problems; and experiencing racial or ethnic discrimination. For the purposes of this study, ACE scores were categorized as answering affirmatively to whether the child had been exposed to 0, 1, 2-3, or 4 or more of the individual ACE measures for assessment of prevalence measures and 0,1, and 2 or more ACE exposures for multivariate analyses.

Outcome variables were BMI and diagnosis of an emotional or behavioral disorder. BMI as an outcome was dichotomized as underweight/normal and overweight/obese for children 6-17 using a cut off at or above the 85th percentile for BMI. Emotional and behavioral health diagnoses were assessed through the construction of a single variable that incorporated positive responses to whether a doctor or other provider had ever told the parent/guardian that the child had attention deficit hyperactivity disorder (ADHD), depression, anxiety, behavior or conduct problems for children ages 2-17. Resilience was defined as “staying calm and in control when faced with a challenge,” for children ages 6–17 and as the child “bounces back quickly when things don’t go [his/her] way” for children ages 2-5. Factors assessed as potential mitigators were: participation in organized sports, clubs, or other afterschool/weekend activities in the past year, regularly reading for enjoyment,

regularly getting enough sleep at least 6 nights per week, having an adult outside of the family that the child can rely on for advice or guidance, getting intense physical activity at least 4 days per week, having a parent that the child can share ideas with, knows most/all of the child's friends, and attends most/all of the child's activities and events for children 6-17; playing with other children at least 4 days per week and having family members that spend time with the child on average twice per day either reading, telling stories, or on trips outside of the home for children 2-5; and eating meals with family members at least 5 times per week, watching more than with 1 hour (2-5 year olds) or 1.5 hours (6-17 year olds) of television per day, using electronics for activities other than school work for more than a half hour (2-5 year olds) or 1 hour (6-17 year olds) per day, and having a parent with a source of emotional support in dealing with the day-to-day stresses of parenthood for all children 2-17.

Statistical Analyses

All statistical analyses were conducted using SAS survey procedures with provided sampling weights to adjust for nonresponse, noncoverage, and give a nationally representative estimate of associations measured. Chi-square tests were run to examine the relationship of ACE with BMI, emotional/behavioral disorder diagnoses (EBD), and demographic characteristics. Multivariate regression was used to determine the association of the variables under investigation with resilience measures and health outcomes adjusting for demographic variables (sex, age, race or ethnicity, income, and insurance status/type). Subgroup analyses were used to test the impact of each independent factor of interest on its potential impact on the relationship between ACE scores and health outcomes.

Results

Prevalence of ACE scores by Demographic Characteristics

As reported by prior studies using the NSCH 2011-2012[8,9,23], the current analysis confirmed that 47.9 percent of children age 0-17 in the US have experienced at least one of the 9 ACEs evaluated. Among 2-17 year olds that number rose to 51.3 percent with 7.1 percent having experienced 4 or more (Table 1). The number of ACEs was positively correlated with increasing age, with more than half of those with 4 or more being in the 12-17 year-old age group. Children with higher ACE scores were also more likely to be non-Hispanic black compared to those with zero ACEs and come from families with lower incomes (those >100% to 200% of the federal poverty line made up 67.6 percent of those with 4+ ACEs). ACE scores were also significantly associated with being uninsured and having public insurance. Resilience in the 2-5 year age group, was significantly associated with lower ACE scores, as was resilience in the 6-17 age group. There were no observed differences with respect to sex (p-0.613).

Prevalence of Emotional/Behavioral Diagnosis by Number of ACEs and Demographic Characteristics

Diagnosis of an emotional or behavioral disorder had a dose-response relationship with increasing ACE score. After adjusting for other sex, age, race or ethnicity, income, and insurance status/type, those with 2 or more ACEs were 3.40 (95%CI: 3.10, 3.88) times as likely to report an EBD diagnosis compared to those with zero (39.1 % compared to 10.9 %). Having a diagnosed EBD was also significantly associated with gender –with male children being 1.84 (95% CI: 1.65, 2.04) times as likely to have an EBD diagnosis –increased age, and with higher levels of income. Being in the highest income category was associated with between 1.25 and 1.33 times the odds of EBD compared to lower levels of income ($p<0.001$). Trends observed for

race, revealed that non-Hispanic white children had significantly higher odds of reporting an EBD compared to all other races ($p<0.001$); and for insurance status showed that children on public insurance had 50 percent higher odds ($p<0.001$) of EBD compared to those with private, but 42 percent lower odds ($p<0.001$) than those who's parents/guardians reported not having any health insurance (Table 2).

Prevalence of Overweight/Obesity by ACE score and Demographic Characteristics

Because BMI was not calculated in the NSCH survey for children less than 6 years of age, BMI analyses were limited to children 6-17. A dose-response association was also evident for BMI categorization and ACE scores, with 38.1 percent of those with two or more ACEs group reporting BMI percentiles in the overweight and obese categories compared to 31.5 percent of those with one ACE, and 26.5 percent of those with zero ACEs. Though adjusting for other variables dampened the magnitudes of these associations, the odds of overweight/obesity remained significantly higher in the those with two or more ACEs compared to those with none. Boys had1.35 (95%CI: 1.21, 1.51) times the odds of being overweight/obese compared to girls; non-Hispanic white children were 56 percent less likely to be overweight/obese compared to non-Hispanic black children ($p<0.001$) and 27 percent less likely compared to Hispanic children ($p<0.001$) with no differences observed compared to those categorized as other; children from lower income brackets had higher odds of overweight/obesity compared to those from the highest, with the strongest effect observed for those in the 100-200%PVL range compared to those about 400%PVL (Table 2).

Effects of and Child/Family Characteristics on Odds on Resilience

Analysis of the factors most associated with children who exhibit resilience

behavior demonstrated that after controlling for demographic characteristics in the 6-17 year-old age group, participation in after-school/weekend sports, reading for fun, regularly getting enough sleep, parents familiar with their child's friends, and parents usually or always attending their child's events were all associated with increase odds of resilience. The factor with the strongest association was the ability of parent and child to communicate about ideas and important matters. Among those demonstrating this quality, the odds of resilience was 3.95 (95%CI: 2.63, 5.93) times those who did not. Meanwhile, both excessive television watching and use of electronic devices were associated with lowered odds of resilience (Table 3). Among those aged 2-5, none of the factors under investigation were significantly associated with resilience (Table 4).

Effects of Resilience and Potential Protective/Risk Factors on Odds of EBD

Both age-related measures of resilience were significant after adjusting for demographic covariates, as well as for all factors tested and maintained the strongest magnitude of effect of all variables tested (Tables 5 and 6). The odds of EBD in children were approximately 70% lower for all children demonstrating resilience ($OR_{6\text{-}17}$ = 0.30, 95%CI: 0.26, 0.35; $OR_{2\text{-}5}$= 0.26 95%CI: 0.18, 0.36) compared to those who did not. For the age group 6-17 participation in organized sports, other after-school activities, reading for fun, getting enough sleep at least 6 nights/week mothers reporting that they had a source of emotional support and were able to share ideas with their children were all associated with lowered odds of EBD. Interestingly, both having an adult mentor outside of the family unit and having parents attend most/all of their events and activities were associated with higher odds of EBD diagnosis. After controlling for resilience, all these factors remained significant except for participation in other after school activities, which retained the same magnitude of effect, but with a marginal p-value. Despite

resilience demonstrating independent associations with several of these factors, controlling for resilience did not alter the magnitude of effect for their associations with EBD, nor the magnitude of its own effect on EBD (Table 5).

Analysis of potential effect modifications to test whether any of the factors under investigation demonstrated a reduction in the odds of EBD for those children with high ACEs revealed that both having a parent that felt they had a source of emotional support and watching more than 1.5 hours of television per day had significant impacts in children aged 6-17. Among children with parents/guardians lacking support and exposure to 1 ACE the odds of EBD were 4.66 (95%CI: 2.55, 8.54) and 8.84 (5.15, 15.18) for those who had 2 or more ACEs compared to none (Figure 1). For children with parents that have emotional support those odds dropped to 1.63 (1.36, 1.94) and 2.59 (95%CI: 1.72, 2.92) respectively (Figure 1). In addition, no effect modification was present for the interaction of resilience and ACE score on EBD outcomes.

Among children aged 2-5 years, in addition to the significant association demonstrated for the resilience measure, playing on several occasions per week with other children was also associated with 39% (p-0.013) lowered odds of EBD, while having family members spending time reading, telling stories, and taking their children on outings weekly was associated with 46% higher odds (p-0.037). These associations maintained significance after adjustment for resilience. As observed for the older age group, controlling for resilience did not alter the effects of the other variables, its own magnitude of effect, nor was resilience independently associated with any of the variables examined for this age group (Table 6). In addition, testing for potential effect modification of the relationship of ACE scores with EBD demonstrated no significant effects for any of the factors evaluated.

Effects of Resilience and Potential Protective/Risk Factors on Odds of Overweight/Obesity

Analysis of the impact of resilience on BMI, demonstrated a smaller impact than that of its effect on EBD outcomes. Resilience was significantly inversely associated with odds of overweight/obesity when adjusting for demographic covariates (OR = 0.88; 95%CI: 0.78, 0.98), but its effect was attenuated and no longer significant after adjusting for the other factors of interest (OR = 0.92; 95%CI: 0.79, 1.08). Of the factors tested, only sports participation and watching more than 1.5 hours of television per day were associated with the odds of overweight/obesity, though with opposite directions of effect. Children whose parents reported that they participated in organized sports or took lessons were 20 percent less likely to have a diagnosed EBD, while children who watched more than one and a half hours of television per day were 32 percent more likely to have a diagnosed EBD. Frequently eating meals with family members was marginally significantly associated with higher odds of negative outcomes (OR= 1.15, p-0.056). Evaluating the effects of these factors on the relationship between ACE score and BMI demonstrated no significant interactions (Table 7).

Discussion

The results of this study support previous findings that ACEs are positively associated with increased odds of emotional and behavioral problems and higher BMIs during childhood, as well as with lowered odds of resilience and an inverse association between resilience and EBD[9, 24]. What this study was also able to demonstrate, were additional associations of EBD, overweight/obesity and resilience with several individual and family level characteristics.

Though other factors were also significantly associated with better outcomes regardless of ACE score, the lack of change in effect size after adjustment indicates that the associations between resilience and EBD and other significant factors and EBD may not be influenced by one another. In addition, not all factors demonstrating associations with resilience, demonstrated similar associations with EBD outcomes, nor did controlling for these factors alter the association of resilience with EBD. Further, interaction analysis did not demonstrate that children with high numbers of ACEs who also demonstrated resilience had better EBD outcomes than those who did not demonstrate resilience. Because temporality cannot be established by this analysis, these results might be indicative of resilience being more of an outcome of having an EBD or of a bidirectional relationship between resilience and EBD rather than a protective attribute. Further, the definition and measurement of resilience used for the purposes of the NSCH may have not fully captured the state of resilience that may be most clinically meaningful.

Among the factors that did demonstrate lower odds of EBD and overweight and obesity and higher odds of resilience for all children regardless of ACE exposure, participation in organized sports was one of the strongest and most consistent. For EMB, BMI, and resilience this association was independent of physical activity level and participation in clubs or other activities. It is very possible that this association is due to children without EMB and of normal weight being more likely to take part in sports, rather than sports having the ability to protect against these outcomes. However, it is worth investigating the potential psychosocial and physical benefits that might be achieved that are independent of having a hobby and being physically active. It may be that the particular blend of social interaction, teamwork, goal setting, and empowerment

combined with purposeful physical activity offers a unique benefit. A few longitudinal analyses and review of cross-sectional studies on this topic have demonstrated evidence in support of this hypothesis[27-29], though additional research in this area, particularly with respect to children with ACEs is needed to further confirm this result. While, this outcome was not evaluated in children under the age of 6, playing often with other children was similarly associated with lowered odds of EBD for those between the ages of 2 and 5, a relationship that may be related to what was observed for older children and sports participation, as it promotes social interaction.

In addition to participation in organized sports; regularly reading for enjoyment, getting enough sleep, having a parent with a source of emotional support and the ability to share ideas with their children were also associated with lower odds of EBD in the older children. These findings are consistent to the previous findings in adult populations of the importance of education and intellectual curiosity, self-care, and social support[25]. Factors that appeared to have positive associations with EBD in this age group were having an adult outside of the family that provided advice and guidance for the child and parents that regularly attended the child's activities and events. These are both puzzling results that are potentially due to families of children with emotional and behavioral issues making greater efforts to spend time with and engage in their children's activities and making sure they have adults in their community that can look after and mentor their children. In the younger aged children, families that spent time reading, telling stories, and taking their children on outings on several occasions per week were also associated with higher odds of EBD. This finding also demonstrated an inverse relationship with time spent playing with other children, potentially highlighting the importance socialization at this age for emotional and behavior growth. For BMI,

excessive television watching was associated with higher likelihood of having a BMI above the 85th percentile. Because this was independent of physical activity level and had a greater magnitude of effect compared to PA, this observed association may be due to increased time spent partaking in sedentary activities having harmful effects independent of physical activity levels as previously observed in other studies[30-32].

The only factor to demonstrate an effect on the relationship between EBD and ACEs were parents having a source of emotional. This finding is perhaps related in some ways to the concept of resilience, as the prior work by Bethel and colleagues also demonstrated that among children with emotion, mental, and behavioral disorders; and more than 2 ACEs, those that had parents with emotional support were more likely to be resilient[24]. Together these results contribute to the growing evidence[23,33] that for children with high ACE scores, a focus on enhancing social support for parents and other members of the family may be highly effective in improving resilience and promoting enhanced health outcomes.

Due to the cross sectional design of this study, the results of the associations assessed in this investigation has several limitations, the most prominent of which is an inability to determine temporality. Though earlier observational work has shown that ACE scores precede many emotional/behavioral and physical ailments, all of the significant associations revealed by the current analysis may occur in conjunction with or as a result of the outcomes under investigation, rather than contributing to their development. This limits the potential of this work to make any definitive assessments of the protective value of any of the factors assessed. In addition, several of the metrics used to measure certain factors may not have been sensitive or specific enough for the purposes of this particular analysis. Though all of the variables included in the NSCH

have been validated, more informative metrics about the frequency and duration of some of the activities may have allowed for more nuanced explorations of their relationships with ACEs, resilience, and EBD and weight related outcomes. Lastly, this study relied on self-reported data and is vulnerable to social desirability bias.

Despite these limitations, the present study also had several strengths, namely the large sample size surveyed. This allowed for sufficient power to conduct many of the subgroups analysis to determine potential relationships that can be more specifically addressed in the future. In addition, the study population was a random sample of the children across the United States, which makes the results of this study highly generalizable to the wider population of American children and highlights the potential for further exploration of the relationships between the salutogenic factors identified, ACEs, resilience, and child mental and physical health.

In order to prove that the factors identified here are potentially protective, more observational studies on this topic are needed. Large-scale longitudinal studies have the most potential to demonstrate how the relationship between resilience and child and family level factors interact and contribute to sustained and improved outcomes as children exposed to ACEs move toward adulthood.

References

1. Felitti VJ, Anda RF, Nordenberg D, Williamson DF, Spitz AM, EdwardsV, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. Am J Prev Med. 1998;14(4):245–58.

2. Goodwin RD, Stein MB: Association between childhood trauma and physical disorders among adults in the United States. Psychol Med 2004, 34(3):509–520.

3. Dong M, Giles WH, Felitti VJ, Dube SR, Williams JE, Chapman DP, Anda RF: Insights into causal pathways for ischemic heart disease: adverse childhood experiences. Circulation 2004, 110(13):1761–1766.

4. Danese A, Moffitt TE, Harrington H, Milne BJ, Polanczyk G, Pariante CM, Poulton R, Caspi A: Adverse childhood experiences and adult risk factors for age-related disease: depression, inflammation and clustering risk factors. Arch Pediatr Adolesc Med 2009, 163(12):1135–1143.

5. Danese A, McEwen BS: Adverse childhood experiences, allostasis,, allostatic load, and age-related disease. Physiol Behav. 2012, 106(1):29–39.

6. Stein DJ, Scott K, Haro Abad JM, Aguilar-Gaxiola S, Alonso J, Angermeyer M, Demytteneare K, de Girolamo G, Iwata N, Posada-Villa J, Kovess V, Lara C, Ormel J, Kessler RC, Von Korff M: Early childhood adversity and later hypertension: data from the world mental health survey. Ann Clin Psychiatry 2010, 22(1):19–28.

7. Pretty C, O'Leary, DD, Cairney J, Wade TJ. Adverse Childhood Experiences And The Cardiovascular Health Of Children: A Cross-Sectional Study. BMC Pediatrics. 2013; 13:208.

8. Wing R, Gjelsvik A, Nocera M, McQuaid EL. Association Between Adverse Childhood Experiences In The Home And Pediatric Asthma. Annals of Allergy, Asthma & Immunology. 2015; 114(5): 379-384.

9. Bethell CD, Newacheck P,Hawes E, Halfon N. 2014. Adverse Childhood Experiences: Assessing The Impact On Health And School Engagement And The Mitigating Role Of Resilience. Health Affairs. 2014; 33 (12): 2106-2115

10. Flaherty EG, Thomson R, Litrownik AJ, Theodore A, English DJ, Black MM. et al. Effect of early childhood adversity on child health. Archives of Pediatric and Adolescent Medicine. 2006; 160: 1232–1238.

11. Flaherty EG, Thompson R, Litrownik AJ, Zolotor AJ, Dubowitz H, Runyan DK. et al. (2009). Adverse childhood exposures and reported child health at age 12. Academics Pediatrics. 2009; 9(3): 150–156.

12. Clarkson Freeman P. Prevalence and relationship between adverse childhood experiences and child behavior among young children. Infant Mental Health Journal. 2014; 35(6): 544-554

13. Kerker B, Zhang J, Nadeem E, Stein R, Hurlburt, M, Heneghan A, Landsverk J, Horwitz SM. Adverse Childhood Experiences and Mental Health, Chronic Medical Conditions, and Development in Young Children. Academic Pediatrics. 2015;15(5): pp.510-517.

14. Falk DE, Yi HY, Hilton ME . Age of onset and temporal sequencing of lifetime DSM-IV alcohol use disorders relative to comorbid mood and anxiety disorders. Drug and Alcohol Dependence. 2008: 94: 234–245.

15. Cohen P, Chen H, Crawford TN, Brook JS, Gordon K. Personality disorders in early adolescence and the development of later substance use disorders in the general 1374 M. D. Glantz et al. population. Drug and Alcohol Dependence. 2007: 88(Suppl. 1): S71–S84.

16. King SM, Iacono WG, McGue M (2004). Childhood externalizing and internalizing psychopathology in the prediction of early substance use. Addiction. 2004; 99: 1548–1559

17. Pardini D, White HR, Stouthamer-Loeber M (2007). Early adolescent psychopathology as a predictor of alcohol use disorders by young adulthood. Drug and Alcohol Dependence. 2007: 88 (Suppl. 1): S38–S49.

18. Appleton A, Buka S, McCormick M, Koenen K, Loucks E, Gilman S, Kubzansky L. Emotional Functioning at Age 7 Years is Associated With C-Reactive Protein in Middle Adulthood. Psychosomatic Medicine. 2011; 73(4):295-303.

19. Slopen N, Kubzansky LD, Koenen KC. Internalizing and externalizing behaviors predict elevated inflammatory markers in childhood. *Psychoneuroendocrinology*. 2013;38(12): 2854-2862.

20. Slopen N, Kubzansky LD, McLaughlin KA, Koenen KC. Childhood adversity and inflammatory processes in youth: a prospective study. *Psychoneuroendocrinology.* 2013;38(2):188–200

21. Rushton FE, Kraft C. Family support in the family-centered medical home: an opportunity for preventing toxic stress and its impact in young children. Child health care providers offer valuable support and connections for families. Child Abuse Negl. 2013;37(Suppl):41–50.

22. Kerker B, Storfer-Isser A, Szilagyi M, Stein R, Garner A, O'Connor K, Hoagwood K, Horwitz SM. Do Pediatricians Ask About Adverse Childhood Experiences in Pediatric Primary Care?. Academic Pediatrics. 2016; 16(2): 154-160

23. Larkin H, Felitti VJ, Anda RF. Social work and adverse childhood experiences research: Implications for practice and health policy. Social work in public health. 2014;29(1):1-6.

24. Bethell C., Gombojav, N., Solloway, M., & Wissow, L. (2016). Adverse Childhood Experiences, Resilience and Mindfulness-Based Approaches. *Child And Adolescent* Psychiatric Clinics Of North America, *25*(2), 139-156. doi:10.1016/j.chc.2015.12.001

25. Dube SR, Felitti VJ, Rishi S. Moving beyond childhood adversity: Associations between salutogenic factors and subjective well-being among adult survivors of trauma. Hurting memories and beneficial forgetting: Posttraumatic stress disorders, biographical developments and social conflicts. 2013 Jan 7:139-53.

26. Centers for Disease Control and Prevention, National Center for Health Statistics, State and Local Area Integrated Telephone Survey. 2011-2012 National Survey of Children's Health Frequently Asked Questions. April 2013. Available from URL: http://www.cdc.gov/nchs/slaits/nsch.htm

27. Eime RM, Young JA, Harvey JT, Charity MJ, Payne WR. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: informing development of a conceptual model of health through sport. Int J Behav Nutr Phys Act. 2013;10(98):1.

28. Jewett R, Sabiston CM, Brunet J, O'Loughlin EK, Scarapicchia T, O'Loughlin J. School sport participation during adolescence and mental health in early adulthood. Journal of Adolescent Health. 2014;55(5):640-4.

29. Vella SA, Cliff DP, Magee CA, Okely AD. Sports participation and parent-reported health-related quality of life in children: longitudinal associations. The Journal of pediatrics. 2014;164(6):1469-74.

30. Exercise physiology versus inactivity physiology: an essential concept for understanding lipoprotein lipase regulation. Exerc Sport Sci Rev. 2004;32:161–6.

31. Hamilton MT, Hamilton DG, Zderic TW. Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. Diabetes. 2007;56:2655–67

32. Wilmot E. G., Edwardson C. L., Achana F. A., Davies M. J., Gorely T., Gray L. J., Biddle S. J. H. Sedentary time in adults and the association with diabetes, cardiovascular disease and death: Systematic review and meta-analysis. Diabetologia. 2012:2895–2905.

33. Murphy A, Steele H, Bate J, Nikitiades A, Allman B, Bonuck K, Meissner P, Steele M. Group Attachment-Based Intervention Trauma-Informed Care for Families With Adverse Childhood Experiences. Fam Community Health. 2015; 38(3): 268–279.

Appendix

Table 1. Distribution of Demographic Characteristics of Children (2-17) by Number of Reported ACEs

		Number of Reported ACEs (%)				
Characteristic	**Among All Children (%)**	**0**	**1**	**2-3**	**4 ≤**	**p[a]**
Total (%)		49.7	25.6	17.6	7.1	
Age						<0.001
2-5	24.4	29.1	23.5	17.1	11.8	
6-11	37.2	37.3	37.4	37.5	35.4	
12-17	38.4	33.6	39.0	45.4	53.8	
Gender						0.613
Male	51.3	51.3	51.6	50.3	52.4	
Female	48.7	48.7	48.4	49.7	47.6	
Race/ethnicity						<0.001
Non-Hispanic white	53.0	57.1	49.3	48.1	50.3	
Non-Hispanic black	13.8	10.3	15.7	19.5	16.4	
Hispanic	23.1	21.8	26.2	22.8	21.8	
Other	10.1	10.7	8.8	9.6	11.5	
BMI (6-17)						<0.001
Normal/Underweight	68.7	73.5	68.5	63.1	59.3	
Overweight	15.6	14.0	15.9	17.3	18.9	

Obese	15.7	12.50	15.6	19.6	21.9	
EBD	14.1	8.0	13.8	22.1	39.1	<0.001
Resilience (ages 2-5)	78.8	81.3	75.6	73.4	71.3	<0.001
Resilience (ages 6-17)	64.7	71.7	62.9	57.7	52.9	<0.001
Income						<0.001
<100% PVL	22.1	16.8	26.2	27.6	29.2	
100-200 PVL	21.3	12.9	25.5	31.1	38.4	
200-400 PVL	29.1	30.7	28.2	28.0	24.0	
400< PVL	27.6	39.6	20.1	13.4	8.5	
Insurance Status/Type						<0.001
None	5.8	4.5	6.8	6.8	8.4	
Public	36.2	24.3	41.2	51.7	63.1	
Private	58.0	71.2	52.0	41.5	28.4	

Abbreviations: ACE- Adverse childhood experiences; EBD- Emotional or behavioral disorder; BMI-Body Mass Index
[a]p-values are for Chi-squared tests

Table 2. Prevalence of EBD and Overweight/Obesity by ACEs and Demographic Characteristics

Characteristic	% with an EBD	AOR[a] (95% CI)	p[b]	% with BMI ≥85th percentile	AOR[a] (95% CI)	p[b]
All Children	14.2			31.3		
ACEs						
0	8.0	ref		26.5	ref	
1	13.8	1.70(1.50, 1.94)	<.0001	31.5	1.07 (0.93, 1.22)	0.345
2 ≤	27.0	3.44 (3.10, 3.88)	<.0001	38.1	1.23 (1.06, 1.42)	0.005
Age (years)		1.17 (1.09, 1.12)[c]	<.0001		0.89 (0.87, 0.91)[c]	<.0001
2-5	3.6			N/A		
6-17	17.5			31.3		
Gender						
Female	10.7	ref		27.8	ref	
Male	17.4	1.84 (1.65, 2.04)	<.0001	34.7	1.35 (1.21, 1.51)	<.0001
Race/ethnicity				26.3		
Non-Hispanic white	16.7	ref		26.3		
Non-Hispanic black	14.0	0.53 (0.46, 0.67)	<.0001	41.6	1.56 (1.33, 1.83)	<.0001
Hispanic	10.1	0.48 (0.39, 0.58)	<.0001	39.9	1.27 (1.07, 1,52)	0.008
Other	11.3	0.58 (0.49, 0.67)	<.0001	28.1	1.03 (0.84, 1.26)	0.798
Income						
<100% PVL	15.4	0.79 (0.67 0.94)	0.006	37.5	1.36 (1.12, 1.64)	0.002
100-200 PVL	17.0	0.75 (0.62, 0.91)	0.004	45.6	1.45 (1.15, 1.82)	0.002
200-400 PVL	13.3	0.80 (0.70, 0.92)	0.002	29.0	1.20 (1.06, 1.39)	0.006

400< PVL	12.9	ref		21.9	ref	
Insurance Status/Type						
None	9.9	0.58 (0.44 0.78)	0.0002	37.6	1.18 (0.91, 1.53)	0.208
Public	17.7	1.50 (1.30, 1.73)	<.0001	42.7	1.20 (1.01, 1.43)	0.036
Private	12.4	ref		24.9	ref	
Resilience (ages 2-5)						
Yes	5.6	0.34 (0.27, 0.44)	<.0001	28.9	0.86 (0.77, 0.96)	0.0305
No	14.9			36.4		
Resilience (ages 6-17)				N/A		
Yes	13.0	0.28 (0.26, 0.32)	<.0001			
No	33.4					

Abbreviations: ACE- Adverse childhood experiences; EBD- Emotional or behavioral disorder; BMI-Body Mass Index, AOR – Adjusted odds ratio

[a]Regression analyses adjusted for all variables presented in this table

[c]p-values for regression coeffients

[c]Effect of age was estimated as a continuous variable

Table 3. Effect of Child/Family Characteristics on Odds of Resilience (Ages 6-17)

Characteristic	AOR[a] (95%CI)	p[b]
Participates in organized sports	1.27 (1.07,1.49)	0.006
Belongs to clubs	1.09 (0.92, 1.28)	0.320
Participates in other after-school activities	1.04 (0.90, 1.21)	0.604
Regularly reads for fun	1.25(1.05, 1.49)	0.011
Has a mentor for advice and guidance	1.24 (0.93,1.66)	0.144
Gets enough sleep 6 days ≤ /week	1.20 (1.03, 1.39)	0.018
Physically Active 4 days ≤ /week	1.15 (0.98, 1.33)	0.092
Watches TV 1.5 hrs ≤ /day	0.79 (0.68, 0.92)	0.002
Uses electronics 1 hr ≤ /day	0.87 (0.74, 1.01)	0.065
Family eats meals together 5 days ≤ /week	1.08 (0.94, 1.26)	0.284
Parent has a source of emotional support	1.18 (0.92, 1.53)	0.199
Parent and child can share ideas or talk about things that really matter	3.95 (2.63, 5.93)	<.0001
Parent knows most/all of the child's friends	1.45 (1.19, 1.75)	0.0002
Parent usually/always attends child's events/activities	1.36 (1.11, 1.69)	0.004

[a]Regression analyses adjusted for all variables presented in this table and demographic variables: age, sex, gender, race/ethnicity, income, and insurance status

[c]p-values for regression coeffients

Table 4. Effect of Child/Family Characteristics on Odds of Resilience (Ages 2-5)

Characteristic	AOR[a] (95%CI)	p[b]
Plays with other children 4 ≤ days/week	1.08 (0.90, 1.30)	0.407
Family members spend time with child (reading, telling stories, or on outings)	1.03 (0.85, 1.24)	0.794
Family Eats Meals Together 5 ≤ days/week	1.10 (0.90, 1.35)	0.363
Parent has a source of emotional support	1.08 (0.82, 1.42)	0.608
Watches 1 hr ≤ TV/day	1.09 (0.87, 1.36)	0.479
Uses electronics 30min ≤ /day	0.99 (0.83, 1.18)	0.925

[a]Regression analyses adjusted for all variables presented in this table and demographic variables: age, sex, gender, race/ethnicity, income, and insurance status

[b]p-values for regression coeffients

Table 5. Effect of Resilience and Child/Family Characteristics on Odds EBD (Ages 6-17)

	W/O Resilience[a]		W/Resilience[b]	
Characteristic	**AOR[c]**	**p[d]**	**AOR[c]**	**p[d]**
Resilience			0.30 (0.26, 0.35)	<.0001
Participates in organized sports	0.69 (0.58, 0.81)	<.0001	0.72 (0.61,0.85)	<.0001
Belongs to clubs	0.98 (0.84,1.13)	0.772	0.99 (0.85,1.15)	0.912
Participates in other after-school activities	0.86 (0.75, 1.00)	0.048	0.87 (0.75, 1.01)	0.070
Regularly reads for fun	0.65 (0.54, 0.77)	<.0001	0.70 (0.58, 0.83)	<.0001
Has a mentor for advice and guidance	1.51 (1.08, 2.12)	0.016	1.66 (1.18, 2.35)	0.004
Gets enough sleep 6 days ≤ /week	0.75 (0.65, 0.87)	0.0001	0.79 (0.68, 0.92)	0.002
Physically Active 4 days ≤ /week	0.91 (0.78, 1.05)	0.197	0.95 (0.81, 1.11)	0.498
Watches TV 1.5 hrs ≤ /day	0.99 (0.85, 1.14)	0.869	0.95 (0.82, 1.11)	0.471
Uses electronics 1 hr ≤ /day	0.96 (0.81, 1.13)	0.600	0.93 (0.79, 1.10)	0.412
Family eats meals together 5 days ≤ /week	1.01 (0.88, 1.18)	0.856	1.03 (0.89, 1.20)	0.689
Parent has a source of emotional support	0.77(0.61, 0.96)	0.018	0.80 (0.64,1.00)	0.052
Parent and child can share ideas or talk about things that really matter	0.37 (0.27, 0.52)	<.0001	0.51 (0.36, 0.71)	<.0001
Parent knows most/all of the child's friends	0.92 (0.77, 1.09)	0.323	1.01 (0.85, 1.21)	0.888
Parent usually/always attends child's events/activities	1.35 (1.07, 1.65)	0.0031	1.42 (1.16, 1.74)	0.001

[a]Regression modeled without resilience

[b]Regression modeled with resilience

[c]Regression analyses adjusted for all variables presented in this table and demographic variables: age, sex, gender, race/ethnicity, income, and insurance status

[d]p-values for regression coeffients

Table 6. Effect of Child Characteristics on Odds of EBD (Ages 2-5)

Characteristic	W/O Resilience[a] AOR[c]	p[d]	W/Resilience[b] AOR[c]	p[d]
Resilience		<.0001	0.26 (0.18,0.36)	<.0001
Plays with other children 4 ≤ days/week	0.61 (0.41, 0.90)	0.0134	0.26 (0.18,0.36)	0.0350
Family members spend time with child (reading, telling stories, or on outings)	1.46 (1.02, 2.10)	0.0374	0.65 (0.44, 0.97)	0.0368
Family Eats Meals Together 5 ≤ days/week	0.88 (0.59, 1.30)	0.5059	1.46 (1.02, 2.10)	0.5050
Parent has a source of emotional support	1.01 (0.57, 1.76)	0.9843	0.88 (0.59, 1.29)	0.9501
Watches 1 hr ≤ TV/day	0.88 (0.51, 1.52)	0.6538	1.02 (0.59, 1.77)	0.7181
Uses electronics 30min ≤ /day	1.26 (0.91, 1.74)	0.1687	0.90 (0.52, 1.57)	0.1265

[a]Regression modeled without resilience

[b]Regression modeled with resilience

[c]Regression analyses adjusted for all variables presented in this table and demographic variables: age, sex, gender, race/ethnicity, income, and insurance status

[d]p-values for regression coeffients

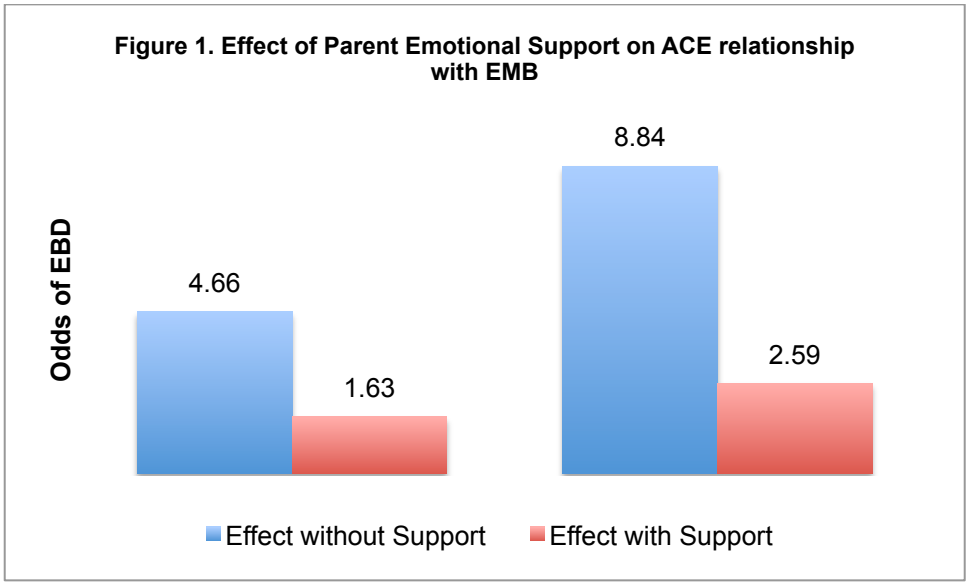

Table 7. Effects of Child Social Characteristics on Odds of Overweight/Obesity (Ages 6-17)

Characteristic	W/O Resilience[a] AOR[c]	p[d]	W/Resilience[b] AOR[c]	p[d]
Resilience			0.92 (0.79, 1.08)	0.311
Participates in organized sports	0.79 (0.68, 0.93)	0.048	0.80 (0.68,0.94)	0.007
Belongs to clubs	1.08 (0.93, 1.25)	0.313	0.98 (0.83, 1.15)	0.778
Participates in other after-school activities	0.97 (0.82, 1.15)	0.734	1.08 (0.93,1.26)	0.311
Physically Active 4 days ≤ /week	0.91 (0.78, 1.05)	0.206	0.91 (0.78,1.06)	0.220

Regularly reads for fun	0.96 (0.78, 1.14)	0.619	0.96 (0.80, 1.15)	0.63
Has a mentor for advice and guidance	0.92 (0.67, 1.28)	0.633	0.93 (0.67, 1.29)	0.668
Gets enough sleep 6 days ≤ /week	0.93 (0.80, 1.06)	0.310	0.93 (0.80,1.08)	0.351
Watches TV 1.5 hrs ≤ /day	1.33 (1.15, 1.54)	0.0002	1.32 (1.14, 1.54)	0.0002
Uses electronics 1 hr ≤ /day	0.96 (0.82, 1.23)	0.640	0.96 (0.82, 1.13)	0.220
Family eats meals together 5 days ≤ /week	1.15 (1.00, 1.36)	0.056	1.15 (1.00, 1.34)	0.056
Parent knows most/all of the child's friends	0.88 (0.72, 1.07)	0.197	0.88 (0.72, 1.08)	0.214
Parent and child can share ideas or talk about things that really matter	1.05 (0.86, 1.29)	0.616	1.05 (0.86, 1.29)	0.616
Parent has a source of emotional support	1.05 (0.82, 1.34)	0.705	1.05 (0.82, 1.33)	0.728
Parent usually/always attends child's events/activities	1.01 (0.68, 1.50)	0.954	1.02 (0.69, 1.50)	0.941

[a]Regression modeled without resilience

[b]Regression modeled with resilience

[c]Regression analyses adjusted for all variables presented in this table and demographic variables: age, sex, gender, race/ethnicity, income, and insurance status

[d]p-values for regression coeffients